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THE RELATION
OF
ELECTRO-THERAPEUTICS
TO
ELECTRO-PHYSIOLOGY.

BY
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ELECTRO-THERAPEUTIST TO THE WOMAN'S HOSPITAL OF THE STATE OF NEW YORK.

[*Read before the N. Y. Society of Neurology and Electrology.*]

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IN the winter of 1865, my attention was, in this way, called to the therapeutics of electricity. While attending at the bed-side of a patient, I met an old gentleman of whom I had frequently heard, and whose name had for years been familiar to very many of the profession in this city. Without possessing the slightest knowledge of anatomy or physiology, or the principles and practice of medicine, this person had, for thirty-five years, followed the so-called business of an electrician, and had treated an enormous multitude of people. I was amused by many of his absurdities of statement, but was thoroughly impressed by his unswerving integrity and vast experience, and I naturally desired to know more of this man's method and processes in a field so little cultivated by the profession at that date.

On many occasions subsequently I carefully watched his methods of procedure, and saw him successful in desperate forms of chorea, neuralgia, and in many other forms of chronic nervous disease. The first case that in this way fell under my observation was a most severe and persistent form of apparent nephralgia. For over five months the patient—a young man of about thirty-five—had every day suffered paroxysmal attacks of pain of the most agonizing character. He had unsuccessfully sought relief in every direction. Seven applications given by this old man secured to the patient complete and permanent relief. A second case that impressed me strongly, occurred in the person of a

little girl, about ten years of age, suffering from a severe form of chorea of eight months standing. She had taken medicine freely and judiciously enough so far as I could judge. Among other things, I found on examining one of her old prescription bottles that was brought for inspection, that Fowler's solution had been taken in considerable quantity. The patient was treated in the usual stereotyped manner of this operator, and within a month, and with less than a dozen applications her recovery was assured.

Here are but two out of many unwritten cases that in this way were forced upon my attention, and induced me at that time to study more closely the clinical side of electro-therapeutics. Now this man knew nothing of electro-physiology, or kindred departments, and while he had a superficial idea of the sensible effects of the constant current, he had never used it, but had confined himself to the simple faradic current.

In short, he existed as a most remarkable example, so far as concerns scientific electro-therapeutics, of profound ignorance and immense experience, associated with perfect honesty of intention. He never enunciated an idea; neither had he any conception of the principle on which he worked and through which he wrought cures. He was, however, so thoroughly the master of the method that he invariably used, that the truth of the saying, "that it is not so much electricity that cures as the manner of using it," never seemed so clear as when comparing his effective manipulations with the awkward slipshod movements that are only too frequently the results of careless attempts at imitation.

This method, which under the name of *General Faradization*, is now quite familiar to the profession, I first described in the N. Y. MEDICAL RECORD, 1866, and published cases illustrative of its powerful constitutional tonic effects. Subsequently, before the New York County Medical Society, I practically demonstrated its modus operandi, and thus was introduced to the profession a method of operation which had, for nearly two score years, been used by outsiders with brilliant success, and which, notwithstanding our increasing knowledge and facilities, and our refined methods of application, is still, I might almost say, the cornerstone of electro-therapeutics.

It would be exceedingly ungracious, not to say absurd, for me or for any one to underrate the importance of a scientific study of electro-therapeutics, or to speak of electro-physiology as of little account in its relations to the former. I fully appreciate the immense aid that the important discoveries in electro-physiology have thus far afforded to the electro-therapist, but I do most decidedly object to that narrowness of view which refuses to accept a clinical fact, because it does not seem perfectly adjusted in its relations to known physiological laws.

If electro-therapeutics is in advance of electro-physiology, as it would certainly appear, we yet know that there are laws in electro-physiology yet to be discovered; that in all departments of science, facts are observed long before a solution is found for them, and that here as elsewhere, we should no more hesitate to accept well-authenticated therapeutical results, because an explanation is not readily found in physiology, than we should hesitate to accept any truth of science in general, because its satisfactory explanation is not immediately at hand.

In order to estimate the value of electro-physiology as a guide to the study of electro-therapeutics, and to form some conception of just how far it should tyrannize over and hold in check our clinical experiments, and the conclusions to be drawn from them, it is well on the one hand to examine in a general way some of the most important known principles of electro-physiology, and on the other to briefly consider the main methods of application.

More than a century has elapsed since the first experimental attempts to determine the degree of excitability of the cerebral hemispheres to the electric stimulus, and although Haller and Zinn had in 1756 referred to convulsive movements that followed irritation of the medullary substance of the brain, the universal testimony of all experimenters, up to 1870, was that the brain could not be excited by our ordinary methods of stimulation.

Very recently Fritsch and Hitzig, using the constant current, followed by Ferrier using the faradic, claimed to have discovered localized centres of movement in the brain—thus merely unearthing as it were the idea

substantially put forth by Haller during the previous century. This theory has been widely discussed, and has raised high expectations in regard to a modification of the old opinions concerning the localization of the cerebral faculties. Carville, Duret, and Dupuy, however, tell us that the above theory is unworthy of acceptance, since their more careful experiments clearly teach that it is impossible to "localize this or that convolution as being the nutritive or functional centre of this or that nerve;" and at a meeting of this Society, not long since, Dupuy quite clearly demonstrated by the galvanoscopic frog and by the division of nerve fibre that the faradic current at least, when applied to the brain substance, is diffused from the cortical portion to those parts known to be excitable.

Now, in whatever light we view these investigations which have so engaged the attention of electro-physiologists; whether further experiment shall unmistakably demonstrate a centre of motion in the brain, or thoroughly disprove it, the practical gain to electro-therapeutics amounts to little.

It will still remain impossible by any external application to exclusively affect any special centres of movement or sensation.

Physiological experiment has simply taught us—and clinical experience has confirmed the teaching—that very mild currents of galvanism when externally applied will directly affect the substance of the brain, and it remains for us to utilize, so far as may be, this fact.

When we come to consider the action of electricity on the spinal cord and sympathetic, we find that here also there is ample ground for speculation, and room for a wide diversity of opinion.

It is no very difficult matter to expose the spinal cord in the living animals, and to show that the direct application of the current is sufficient to throw the muscles of the trunk and of the extremities into violent contractions. It is as easily demonstrated that if the cord be traversed for some time by the current, that portion which is under the electrical influence finally becomes insensible to all forms of stimulus—mechanical, chemical or faradic. A so-called inhibitory effect is produced. Finally, it is agreed that when the fara-

dic current is applied directly to a certain portion of the upper part of the cord the excitation is transmitted to the cervical sympathetic nerve, and from thence to the radiating fibres of the iris which it animates; similarly by electrization of that part of the cord which traverses the fourth lumbar vertebra, it is possible to induce very appreciable contractions of the vasa deferentia—the bladder and the rectum.

I remarked that it was no very difficult matter to demonstrate the above phenomena, but it is exceedingly difficult to determine just to what extent it is possible to affect the spinal cord in the living man by simple external applications.

If it were possible in our treatment of disease of the cord to directly and solely localize the current, it can readily be seen what increased facilities would be ours in dealing with certain pathological conditions. This unfortunately we cannot do, but as in the application of electricity to the brain, so here we have positive evidence—both clinical, experimental, and pathological—that the galvanic current externally applied certainly penetrates to and appreciably affects the cord itself. Thus electro-physiology again confirms and renders certain the suggestions of clinical experience, and once more it remains for us to utilize, so far as may be, the truth at hand.

The effects of electrization of the exposed sympathetic nerve are so familiar as scarcely to need mention. The well-ascertained fact that the faradic current contracts the blood vessels and lowers the temperature of a part, while the galvanic augments the circulation, is further confirmed by electro-therapeutical observations. The circulation in the arterioles, it is found, is variously modified according to the direction of the current.

The ascending current, acting on a frog's web, constricts the arteries and thereby renders the circulation less active, while the descending current acts in a manner directly opposite.

It must be admitted that electro-physiology is encumbered with many inconsistencies and contradictions, which very materially impair its usefulness as a constantly reliable guide; but the above, with numbers of other equally well ascertained results of phy-

siological investigation, attest its immense importance, and forcibly illustrates the possibilities of a more complete adjustment of the two departments of physiology and therapeutics in the future.

In no other portion of electro-physiology is this uncertainty more manifest than in the experiments in regard to the effects of the closed galvanic circuit on both the muscles and the motor and sentient nerves. One conclusion to which several physiologists hold is, that an inverse current applied to a frog in whom tetanic convulsions have been induced by the poison of strychnia, will dissipate the tetanus.

Matteucci endeavored to utilize this asserted power of the current in the treatment of a case of trismus, but with unsatisfactory results.

A modification of this general statement is found in the assertion of Pflüger, that the irritability of a nerve is lessened only by an inverse current of great tension, while a current of comparative mildness, having the same direction, results in an increase of irritability. The direct current, he claims, produces effects the reverse of this. The phenomenon called "Ritter's tetanus" is an illustration of a still more radical discrepancy; for this observer distinctly states that the direct current has a soothing or paralyzing effect on a motor nerve, while the inverse current increases irritability.

On the other hand, there is, as was suggested, a brighter side to the picture. The influence of tension and direction of the current over the vaso-motor nerves is a guide, more or less capricious, it is true, yet a most useful guide in our efforts to adapt methods of application to certain pathological conditions.

In the power of a current to restore the lost excitability of a nerve, and in the superiority here of the inverse over the direct, and scattered through the whole department of the physiology of electrotonus, in fact, we find sufficient groundwork on which to rear much that will enter as important truths into our system of electro-therapeutics.

It is claimed that a remedy, in order to be "*indicated*" in any special disease, must have certain well-known methods of physiological action that directly meet or counteract the observed pathological condition.

This is, to a certain extent, true. For the relief of a dry skin and a high pulse we resort to diaphoretics and arterial sedatives. To reduce the volume of blood in the brain we have bromide of potassium, and so on; but can any one tell us minutely and satisfactorily why it is that quinine has a controlling influence over the manifestations of malarial poison, why iodide of potassium tends to eradicate the syphilitic poison, or why opium causes sleep? And yet quinine is indicated in intermittent fever, iodide of potassium in syphilis, and opium in insomnia; although each may at times signally fail to accomplish the desired result.

I freely admit that the special indications for galvanization of the brain, spinal cord, and sympathetic, especially the former, are not by any means so precise or well understood as are the indications for the administration of the above remedies. Perhaps they may never be, but possibly and probably the advance of electro-physiology, aided by clinical experience, will give more exactness to our knowledge.

Because we cannot localize the galvanic current in special portions of the brain; because we cannot perfectly explain or understand its physiological action on the centres of thought and motion, or why this action seems to be frequently adapted to the relief of many symptoms of cerebral disturbance; and, finally, because we cannot uniformly predict that relief will follow the use of central galvanization in certain conditions, it should be no bar to our use of it in this way, and our acceptance of it as a useful remedy in cerebral disease, even although it cannot be said to be indicated in the full sense that a remedy is indicated, which has stood the test of years, and whose exact physiological action is known.

I am led by these considerations of some of the main points of electro-physiology, directly to the question, What methods of electrical application ought to be accepted and recognized by the profession as of incontestable value? And *first* we mention *localized electrization*, since it is the most ancient of all the methods, and probably the only one which is universally recognized, and against the propriety of which no dissenting voice is raised.

2d. *Galvanization of the brain*.—It is so thoroughly

established that external applications of the current penetrate directly to and appreciably affect the brain, and, furthermore, it is so palpable to any one who has had much real and rightly-guided practical experience in electro-therapeutics, and whose views are not prejudiced by a too blind and devoted adherence to theoretical considerations, that such applications are often of immense service, that it would be unnecessary to advocate its utility, were it not that authoritative names were pledged to its condemnation. I cannot attempt, in a paper of this character, to consider fully the grounds of this condemnation; but a reference to some of the objections of Cyon, as put forth in his "*Principles of Electro-Therapeutics*," cannot fail (to say the least) to show their unreasonableness, and to carry the conviction that the learned teacher is more theoretical than practical.

3d. Galvanization of the Spine and Sympathetic.—Here again there can be no doubt in regard to the power of the current to penetrate to the nerve-tissues in question.

To be more specific concerning some of the opinions of Cyon, relating to galvanization of the nerve-centres—take his statement in reference to the relative conductivity of the tissues surrounding the cord, and the inference he deduces therefrom. Because the conductivity of the cord is ten times greater than that of the bones surrounding it—while the conductivity of the ligaments through the openings between the apophyses along which the current necessarily travels to reach the nerve-centre, is about equal to the conductivity of the cord—it is asserted that the current will by preference and with all its intensity act upon the cord. He further says, that if the cord was immediately surrounded by a better conductor, say muscle instead of bone—currents of great intensity would be required to affect the nerve-centre, since the flow of the electricity would be diverted by the better conducting muscular tissue. Hence, Cyon concludes that only mild currents should be used when the spine is submitted to galvanization. Such an idea as the above, coming from some less distinguished quarter—would be termed absurd to the last degree. Without any foundation in fact, or therapeutical experience, it

would seem to have originated in the depths of his moral consciousness alone, and I take occasion to make this reference from the self-evident fact that the progress of electro-therapeutics may be impeded by the too dogmatic assertions, and the too refined and highly wrought deductions of the purely physiological investigator; as well as by the exaggerated reports of ignorant and credulous charlatans.

4th. General Faradization.—Of this method I can only say that it is to me absolutely indispensable in the practice of electro-therapeutics. Beginning with this method nearly ten years ago, and at first confining my manipulations in electricity almost exclusively to it, I have not, to this day, seen cause to abandon its practice.

New and valuable methods of application have been proposed and adopted. Through a better and increasing knowledge of its subtle and far-reaching influence, and of the laws which regulate its action, the constant current is indicated over a wider range of neurotic affections, and alone occupies the field of electro-surgery; and yet, if I might roughly approximate the relative frequency with which I even now make use of general faradization in its most thorough form, and all other processes of faradization and galvanization, I should say that fully one-third of the cases indicating electricity are subjected to the first-named method.

There is no tonic influence in medicine comparable with it in power; there is none to which can be accorded such a wide range of application. Why then is it not better understood and more used by the profession, and especially by those who profess mastery in electro-therapeutics? Two reasons would seem to account for this neglect.

First. The time and labor requisite for its successful performance, and the unwillingness of the physician to subject himself or his patient to trouble.

Time certainly is required, and tiresome labor; and so far am I from loving labor for its own sake, that were it not that I know from long experience the impossibility of satisfactorily supplying its place by other methods, I should be among the last to advocate its importance.

Althaus, in his work on medical electricity, speaks favorably and fairly enough of general faradization; but in his estimate of the rationale of its operation, and the effects of the current on the operator—and especially when he would practically discard the method, because he conceives it to be inferior to the application of the constant current for a few minutes—falls into the natural error of one whose opinion is based on theory alone.

It is evident that Althaus has never made even an approach to a satisfactory use of the method. And not only is time and patience required, but much care and not a little skill, which comes only after repeated endeavors.

Second. Another fallacious reason for rejecting general faradization lies in the fear that its relations with electro-physiological laws cannot be fully explained. This objection has already been noticed, but I can give no better illustration of the unreasonableness of the objection, than by mentioning a case of disease of the supra-renal capsules (Addison's disease) reference to which may be found in the recent edition of Flint's Practice of Medicine. For eighteen months the patient, a man aged forty-five, had suffered from an exhaustion so complete, that he could with difficulty drag himself about.

Persistent tonic medication had failed to relieve him in the slightest degree. General faradization was, however, followed by such immediate and unusual results in approximately restoring the strength and the impaired functional activity of the various organs, that I presented the case before the Medical Library and Journal Association as proof, not of the power of the method to cure Addison's disease, but as unmistakable evidence of its remarkable tonic power. Objection was made to the presentation, on the ground first, that the case could not be one of Addison's disease; and secondly, that the method of treatment was not physiological. Concerning the first objection it may be said that a post-mortem, two years subsequently, confirmed the diagnosis; in regard to the second objection I have nothing to remark.*

* The specimen, together with a history of the case, was presented before the New York Pathological Society.

A fair survey of the entire field of electro-physiological experiments in their relations to electro-therapeutics seems to lead to the following conclusions:

First. Electro-physiology teaches us how to use electricity both in health and disease, *i. e.*, it must, to a great extent, guide us in our numerous methods of special application and in the multifarious manipulations called for in general and localized electrization.

Second. We are taught by these investigations, more correctly and minutely than by any clinical experience in the treatment of disease, the exact effects of the different manifestation of electricity on nerve and muscle.

Third. It enables us to intelligently discriminate in our selection of those pathological conditions that are likely to be benefited by electrical treatment—thereby saving much useless labor in experimental trials.

Fourth. It aids us both in diagnosis and prognosis, although it does not always fully, and frequently it fails wholly, to explain the most positive and brilliant therapeutic results.

In conclusion I would say that medical electricity is the legitimate property of the educated physician alone. On him depends the probability of its elevation and expansion, and on him as well rests the responsibility of its possible degradation and virtual destruction. In all probability its future status is secured, for it rests on foundations too solid to be easily overthrown, but it has grown and is still growing in spite of the opposition of those who would relegate its use to ignorant attendants or to the patients themselves, or who, with limited knowledge of the subject and less experience in its use, assert that their efforts and results in this special department compasses all that there is to electro-therapeutics.

